



Segmented SXT Mirror for Constellation-X

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Segmented SXT Mirror

Outline

- Technology demonstration plan
- Process development progress
- Infrastructure development progress
- Issues



Segmented SXT Mirror

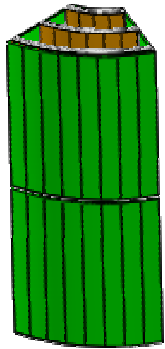
Technology Development Plan

- **Need to completely rethink mirror design**
Segment length, reflector thickness, mass
- **Modular design accommodates progressive buildup**
- **Develop processes using Astro-E scale (20 cm diameter)**
- **Engineering model using 50 cm mandrel (inner flight module)**
Demonstrate and refine mounting and alignment approaches
Ready for X-ray tests in early 2003
- **Prototype is progressive build of 3 modules (1 inner, 2 outer)**
Demonstrate use of largest and first segmented mandrels
Demonstrate module alignment
First 10 m focal length system
- **Build up industrial partnerships and lay groundwork for flight development**



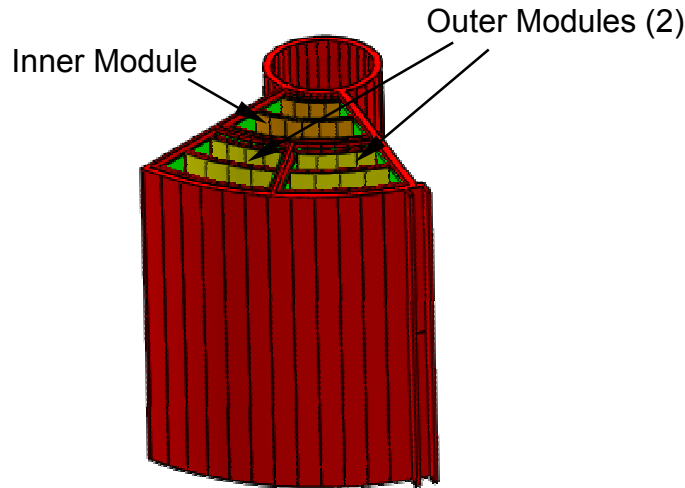
SXT Strawman Design

Engineering Unit



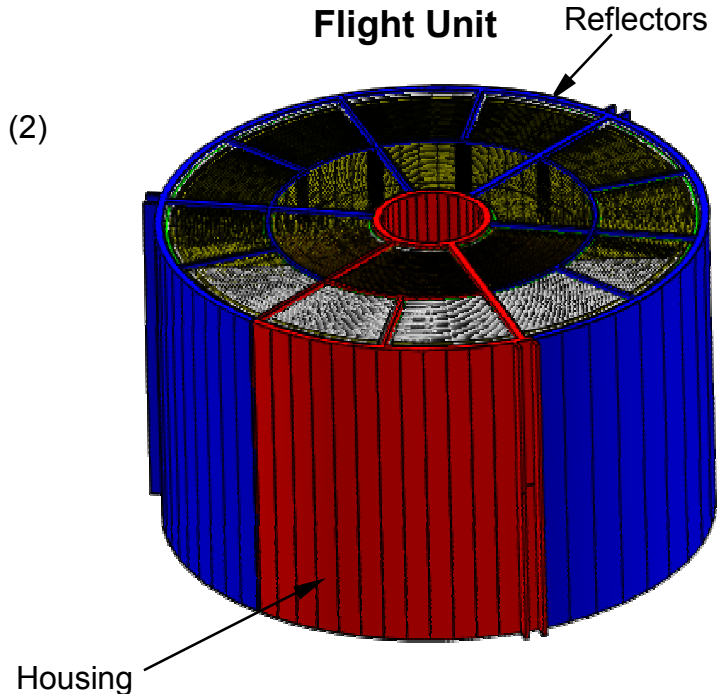
- Single inner module with
- 0.5 m dia. reflector pair (replicated from Zeiss precision mandrel)
 - Parabolic (P) and Hyperbolic (H) submodules
 - First modules to be aligned using etched silicon microcombs

Prototype Unit



- Flight Scale Assembly of
- 3 modules (2 outer and 1 inner)
 - Largest diameter same as for flight - 1.6 m
 - Each module has 3 to 9 reflector pairs
 - Demonstrates module to module alignment

Flight Unit



- Full flight Assembly
- 1.6 m outer diameter
 - 18 Small Modules
 - 70 to 170 reflector diameters



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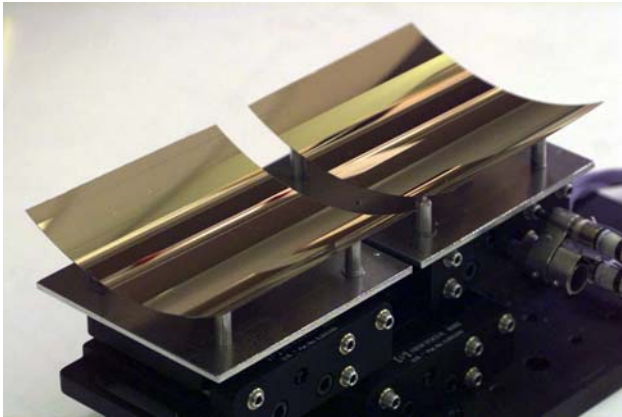
Process Development

- Producing conical reflectors with azimuthally constant figure
- Angular resolution limited by mandrel quality (using Astro-E mandrels)
- Replication off metal mandrels is problematic (even when passivated)
- Have developed SiO_2 coating process for metal mandrels
 - Makes possible use of cylindrically symmetric mandrels for some reflectors
 - Allows for parallel mandrel manufacture
- Now have cylindrical and conical secondary mandrel with $<10''$ figure
- Segment cutting process has been refined
- Wolter mandrels are being fabricated
- Beryllium shown to be viable alternative substrate material
- Optical design and analysis code development continues
- Metrology approach being defined for every process step

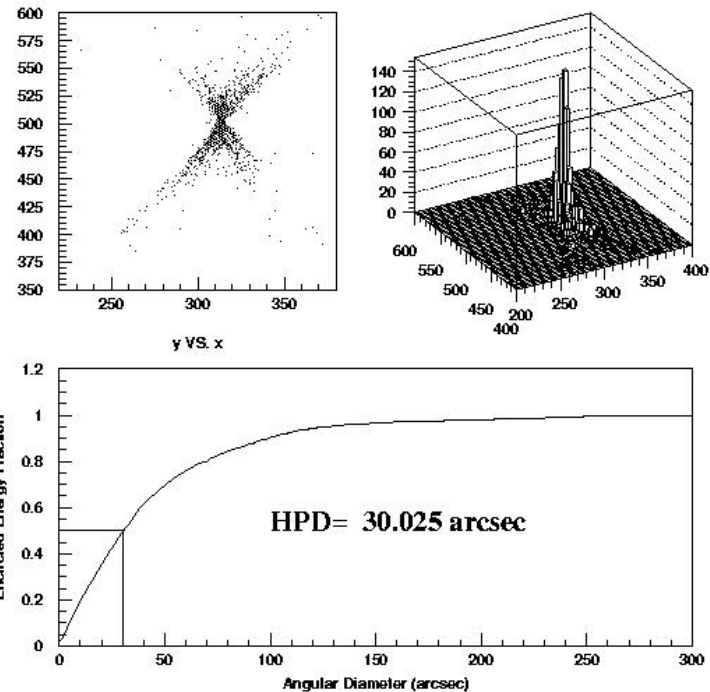


Segmented SXT Mirror

X-ray measurements of conical glass reflector pairs



Fixture for X-ray and visible light tests of reflector pairs. Reflectors are held at 4 points. Fixture has multiple degrees of freedom;



X-ray measurement of fully-illuminated reflector pair yields HPD of 30".

Reflectors were replicated using cylindrical Astro-E mandrels.

Sources of error include mounting scheme and mandrel figure errors.

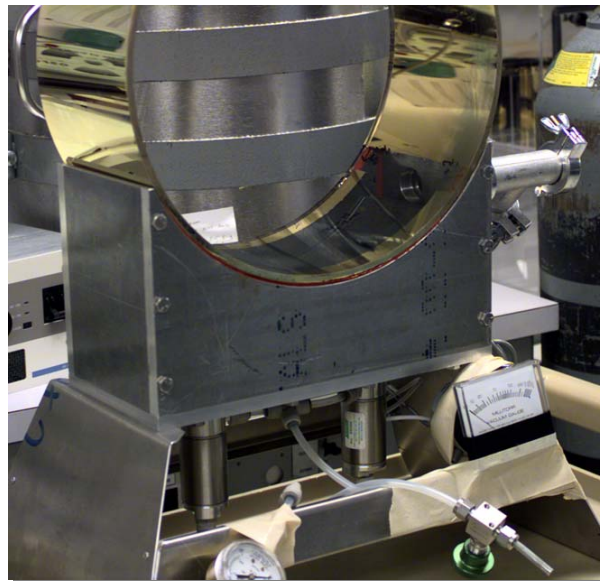
Error shown to be dominated by mandrel quality



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Infrastructure Development

- Geared toward 50 cm replication off Zeiss mandrel and EM
- Large oven has been delivered and assembled
- Portable replication device has been invented and demonstrated
- Feasibility of replicating off Zeiss mandrels studied using Be segments
- Initial glass replication within a month





Segmented SXT Mirror

Issues

- **Limits of substrate**

- Length

- Figure

- Ability to cut accurately

- Thickness

- **Alignment combs**

- Degree to which imperfect reflectors can be brought into alignment

- **Design trades**

- Number of mandrels - can we produce more than one radius reflector?

- Do we need to vary the substrate thickness with radius?